National Hydrologic Assessment

March 16, 2017

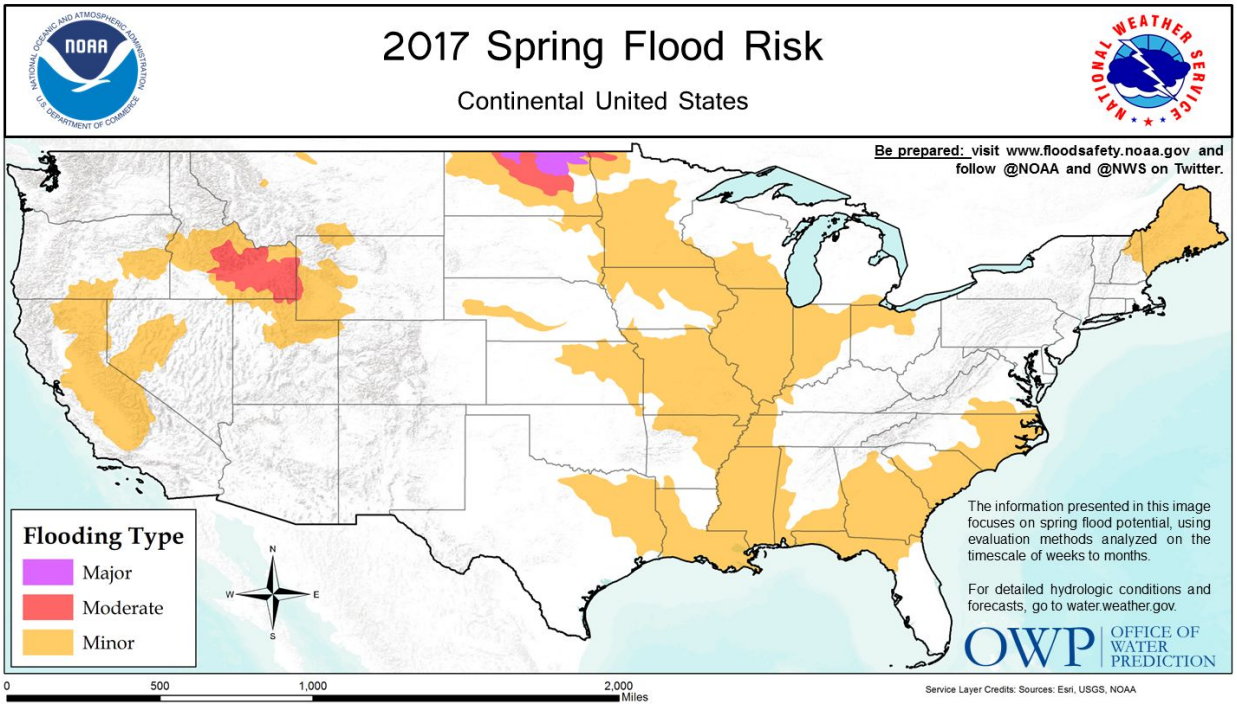

Figure 1: National Spring Flood Risk defined by risk of exceeding Minor, Moderate, and Major Flood Levels

Executive Summary

This analysis of flood risk and water supply for Spring 2017 integrates late summer and fall precipitation, frost depth, soil saturation levels, stream flow levels, snowpack, temperatures and rate of snowmelt. A network of 122 weather forecast offices and 13 river forecast centers nationwide assess this risk, summarized here at the national scale. Areas across the country that are at risk of exceeding major, moderate, or minor flood this spring are shown in Figure 1.

Northern portions of the Red River of the North Basin, as well as the Souris River and Devils Lake Basins are expected to exceed major flood levels this spring. Wet antecedent conditions combined with heavy winter snowfall has significantly enhanced the risk of flooding in these basins. Rivers in the northern plains of the Missouri River basin are expected to exceed minor flooding due to a combination of a significant snowpack and wet soils across portions of North and South Dakota. Minor flooding is expected on small streams and rivers in the lower Missouri basin and on the mainstem Missouri River below Nebraska City. While soil moisture content is low across much of the lower basin, flooding in this area is often driven by individual convective rain storms typical during the springtime.

A mild winter has prevented buildup of a snowpack, and shallow frost depths, combined with elevated fall streamflows and above normal winter precipitation has resulted in soil

moisture and streamflows remaining high across southern Minnesota, northern Iowa, and Wisconsin. These conditions make this area vulnerable to flooding if heavy spring rains occur.

A heavy mountain snowpack leads to the threat of minor flooding along some tributaries to the Milk and Yellowstone Rivers in Montana and in the Wind River Basin in Wyoming.

Rivers and streams in the Ohio River basin and Cumberland and Tennessee River Valleys typically experience minor flooding in the springtime. There is a threat of minor flooding in these basins throughout spring. Any increase in flood potential will be driven by individual convective rain storms typical in the spring.

There is a risk of minor flooding across much of Maine and into northern New Hampshire. A deep snowpack with above normal water content will leave the area vulnerable to any heavy rainfall events this Spring. Additionally, there is extensive river ice in place at this time, creating an additional threat for jams when the snowpack melts.

Although the Southern US, from East Texas into the lower Mississippi Valley and across the Southeast are currently experiencing low streamflows and dry soils, heavy rainfall which is a typical occurrence during the late winter and early spring can cause can generate minor and even moderate flooding river flooding at any time.

Idaho, which saw its fifth wettest winter according to NOAA's National Centers for Environmental Information, has already experienced snowmelt and rain-on-snow flooding due to a warm February. There is a risk of exceeding moderate flooding due to additional snowmelt during the Spring, particularly in the Snake River basin in in south-central and southeast Idaho. Minor flooding is possible elsewhere from southeast Oregon across southern Idaho.

For much of California and Northern Nevada, there is an elevated risk of spring flooding due to much above average snowpack, wet soil conditions, and above average reservoir storage levels. Flooding throughout this region could occur from snowmelt, rain, or a combination or both.

In the Upper Colorado River Basin, there is generally an elevated risk of Spring flooding, particularly in the Green River and Duchesne River Basins where record-setting snowpack conditions will contribute to likely spring flooding. Additionally, record-setting snowpack exists in the Bear River Basin, located in the northeastern portion of the Great Basin, where minor flooding events have already been observed due to much above average precipitation and snowmelt at low-elevation areas. There is an elevated risk of spring flooding due to much above normal snowpack conditions in the Weber River and Provo River Basins as well, in addition to the aforementioned Bear River Basin.

The flood potential from snowmelt and ice jams throughout Alaska this spring is currently rated as normal. This would indicate that locations that often experience flooding during breakup are likely to see minor flooding if an ice jam forms downstream. This forecast is based on current ice thickness, observed snowpack, river freeze-up stage, and long range weather forecasts.

Heavy rainfall at any time can lead to flooding, even in areas where overall risk is considered low. The latest information for your specific area, including official watches and warnings should be obtained at: http://water.weather.gov

Current water supply forecasts and outlooks in the western United States range from below average in the Upper Missouri Basin to near to much above normal in the Pacific

Northwest, throughout the Sierra Nevada, the Great Basin and in the upper Colorado River basin.

Heavy Rainfall and Flooding

The information presented in this report focuses on spring flood potential, using evaluation methods analyzed on the timescale of weeks to months, not days. Heavy rainfall at any time can lead to flooding, even in areas where overall risk is considered low. Rainfall intensity and location can only be accurately forecast days in the future, therefore flood risk can change rapidly.

Stay current with flood risk in your area with **the latest official watches and warnings at** weather.gov. For detailed hydrologic conditions and forecasts, go to water.weather.gov.

NOAA's Experimental Long Range River Flood Risk Assessment

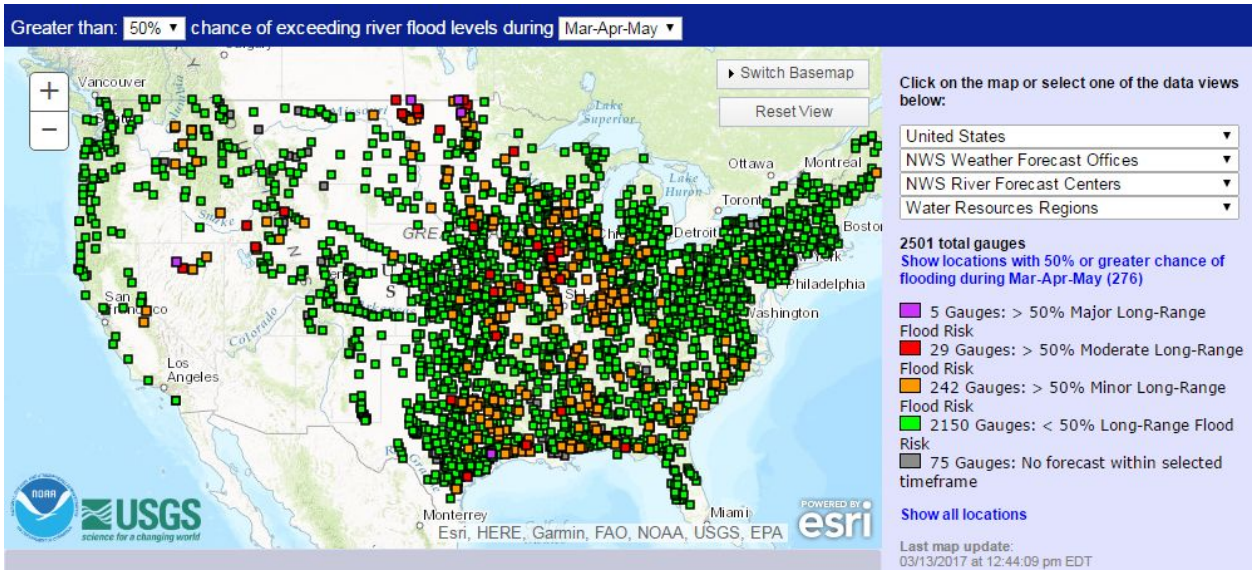

Figure 2: Greater than 50% chance of exceeding minor, moderate, and major river flood levels during March – April - May

At the request of national partners including FEMA and the US Army Corps of Engineers, NOAA continues its improved decision support services with the "Experimental National Long Range River Flood Risk" web page available at: http://water.weather.gov/ahps/long_range.php. Here, stakeholders can access a single, nationally consistent map depicting the 3-month risk of minor, moderate, and major river flooding. This risk information is based on NOAA Ensemble Streamflow Prediction (ESP) forecasts which are generated for thousands of river and stream forecast locations across the nation. With this new capability, stakeholders can quickly view flood risk for levels which are known to affect their specific area of concern. These enhancements improve the value of the National Hydrologic Assessment, by clearly and objectively communicating flood risk at the local level.

The sections below quantify river flood risk based on the river location having a 50% or more likelihood of exceeding minor, moderate or major flood levels. The National Weather Service (NWS), in coordination with local officials, defines flood levels for each of its river forecast locations, based on the impact over a given area. The flood categories are defined as follows:

- **Minor Flooding -** minimal or no property damage, but possibly some public threat (e.g., inundation of roads).
- **Moderate Flooding -** some inundation of structures and roads near stream. Some evacuations of people and/or transfer of property to higher elevations.
- **Major Flooding -** extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations.

For example, on the Red River of the North at Fargo, ND, Moderate Flood Stage is 25 feet. At that height, city parks and recreation areas near the river are impacted. The impacts of all floods are local and, as such, this information is unique for each forecast location. To access local flood impact information, visit water.weather.gov and click on any river service location.

Risk of Exceeding Major Flooding

Red River of the North, Devils Lake, and Souris River Basins

There is a chance of exceeding major flooding in the northern reaches of the Red River of the North, and in the Devils Lake and Souris River Basins. Much of the Upper Midwest region was wetter than normal through the fall and early winter months. Above normal snowfall and soil moisture across parts of North Dakota and Minnesota has lead to an increased risk of moderate to major flooding in these areas. The Pembina River at Neche could see flows similar to the spring floods of 1979 or 2006. In the Devils Lake Basin, a wet summer and fall, along with near record winter snowpack has set the stage for much above-normal runoff into the lakes. Though intermittent thawing has or will occur, moisture remains locked in the snowpack. Devils/Stump Lake could rise 3 to 4 feet above current levels through the coming spring runoff season. A rise of approximately 4 ft would match the record lake level set in 2011.

Risk of Exceeding Moderate Flooding

Snake River Basin

There is a risk of exceeding moderate flooding in south-central and southeast Idaho. Minor flooding is possible from southeast Oregon into southern Idaho. Relatively warm weather accompanied by rain in February caused much of the snow in the lower valleys of southern Idaho to melt. However, substantial low elevation snow remains, particularly across portions of south-central and eastern Idaho. Snowpack is still building, but is already very high across much of the south-central and southeast portions of the state. These factors lead to an enhanced risk of flooding during the spring snowmelt season.

Risk of Exceeding Minor Flooding

California and Nevada

Due to a substantial snowpack, it is very likely that parts of California and Nevada will experience snowmelt flooding in the spring. Basins draining from the Sierra Nevada of Oregon and California into the Sacramento–San Joaquin River Delta are likely to experience snowmelt flooding, along with the Carson, Walker, and Truckee River Basins in Nevada. Flooding is also likely along the Humboldt River in Nevada, with risk being higher in the Lower Humboldt . As the snowpack is expected to persist or build over the next month, Mid-March is still too early to determine final spring flooding potential due to snowmelt across the western United States. The duration and intensity of flooding will depend strongly on future precipitation and temperatures.

Colorado River Basin and Eastern Great Basin

Due to record-setting snowpack conditions in the Upper Colorado River Basin and Eastern Great Basin regions, flooding is likely in the Green River and Duchesne River Basins located in the Upper Colorado River Basin, and in the Bear River, Weber River, and Provo River Basin located in the northeastern portion of the Great Basin. Minor flooding events have already been observed in the Bear River Basin, as above normal precipitation combined with snowmelt-driven runoff at low elevations. The risk of flooding in these areas will persist throughout the Spring as many areas have well exceeded peak snowpack conditions usually not realized until early April, with the potential for further accumulation through March and early Spring.

Current volumetric forecasts for the April through July runoff period are generally much above average for the Upper Colorado River Basin and Eastern Great Basin. While spring temperatures affect the pattern of snowmelt runoff and consequently the magnitude of peak flows and possible flood events, peak flows roughly correspond to volumetric flows in their magnitude. It is also important to keep in mind that an extended period of much above normal temperatures or heavy rainfall during the melt period can cause or exacerbate flooding problems during any year.

Missouri River Basin

Many rivers located in the northern plains of the Missouri River basin are expected to exceed minor flooding due to a combination of a considerable plains snowpack in North Dakota and wet soils in Montana, North Dakota, eastern South Dakota, and northwest Iowa. Rivers expected to experience minor flooding in this area include the James in North Dakota and South Dakota, along the Cannonball and Little Muddy in North Dakota, and the Little and Big Sioux Rivers, and the Floyd and Rock Rivers in Iowa. In Nebraska, minor flooding is possible this spring along the lower reach of the North Platte and mainstem Platte River in central Nebraska from above-normal mountain snowpack and reservoir conditions. In the mountainous west, minor flooding is expected along some tributaries to the Milk and Yellowstone, such as the Sun River, Clear Creek, and Clarks Fork Yellowstone River in Montana, and in the Wind River Basin in Wyoming.

In the lower Missouri River Basin, minor flooding is expected on small streams and

rivers. While soil moisture content is abnormally low across much of the lower basin, flooding in this area is driven by individual convective rain storms typical during the springtime. Specifically, minor flooding is anticipated along Stranger Creek in eastern Kansas and within the lower Big Blue River basin and Osage River Basins in Kansas, as well as in the Osage, Platte, and Chariton River basins in Missouri, along several of the smaller tributaries to the Missouri River in Missouri, as well as along certain reaches of the mainstem Missouri below Nebraska City.

Upper Mississippi River Basin

Precipitation this winter has been normal to above normal in the upper reaches of the Mississippi drainage in Minnesota, Wisconsin, and northern Iowa; these areas also experienced above normal streamflow during the fall. Much of the snowpack has already melted due to a very warm winter, so the risk for near-record spring snowmelt floods is reduced. However, these areas are still vulnerable to heavy spring rain events due to the wet antecedent conditions. Overall, these factors contribute to a slightly increased risk of minor flooding at a few locations in Minnesota, Wisconsin, and northern Iowa. Additionally, a persistent snowpack in northern Minnesota further contributes to an elevated risk of minor flooding in the Mississippi Headwaters area.

The chances for flooding across southern Iowa, eastern Missouri, Illinois and northern Indiana are near normal. Spring tributary flooding in these areas and along the mainstem Mississippi River will be driven by spring convective storms. Minor to moderate flooding is common at many locations during the spring in these parts of the Upper Mississippi River Basin.

Ohio, Cumberland, and Tennessee Valleys

While snowpack in the Ohio River Valley has largely dissipated, much of the susceptibility to flooding in this region is driven by individual convective rain storms typical in the spring. A risk of minor flooding exists in the Wabash, Little Wabash, White, Maumee and Muskingum basins and possibly in the Great Lakes drainages through Illinois, Indiana and Ohio, and in the Kentucky, Green, and Upper Cumberland River basins in Kentucky. Lingering dry conditions combined with ample flood storage capacity in Cumberland Basin reservoirs will help mitigate flood potential in that area. In West Virginia, isolated minor flooding is possible in the Monongahela and Little Kanawha basins.

Lower Mississippi River Valley and Eastern Texas

Although the lower Mississippi Valley and parts of East Texas are currently experiencing low streamflows and dry soils, heavy rainfall which is a typical occurrence during the late winter and early spring can generate minor and even moderate flooding flooding at any time. There is a chance of exceeding minor flooding across much of the Lower Mississippi River Basin and into Eastern Texas. This includes the Lower Mississippi and Atchafalaya Rivers, and the Sabine, Neches, and Trinity Rivers in Texas and on the Pearl and Big Black Rivers in Mississippi.

Southeastern United States: Alabama to North Carolina

Minor flooding is possible for river systems along the Gulf and Atlantic Coasts of the Southeast, including Southern Alabama, the Florida Panhandle, Georgia, and eastern portions of South Carolina, North Carolina, and Virginia. This flood potential is driven by individual convective rain storms typical in the spring falling in basins where near to above average soil moisture conditions exist.

Maine and Northern New Hampshire

Several systems from late January to mid-March brought heavy snowfall to the Northeast, creating a deep snowpack with above normal water content. Although river flows are generally near normal, reservoir levels are near to above normal, and long term moisture states are close to normal, current heavy snow cover will take a long time to melt off, leaving the area vulnerable to any heavy rainfall events as we approach Spring. Additionally, there is extensive river ice in place at this time, creating an additional threat for jams when the snowpack melts. This brings a risk of exceeding minor flooding across Maine and into parts of Northern New Hampshire.

Other Regions/Low Flood Risk Areas

Pacific Northwest

Rivers east of the Washington Cascades reach their annual peak in late spring or early summer when the mountain snowpack melts and runs off. The snowpack usually reaches its annual maximum in April and rivers typically crest between mid-May and mid-July. As a general rule the larger the snowpack is at the end of the season, the higher the river crests will be.

This winter has already brought a greater extent and depth of snowpack, increasing the chances of flooding on small creeks and streams once that snow begins to melt. Even in areas where the spring flood risk might be lower, some smaller streams and flood prone rivers may experience minor flooding with a sudden large warm-up or the occurrence of heavy rain or thunderstorms over those watersheds. Flooding during the snowmelt season can occur anywhere when heavy rain falls in a river basin if the rain is intense enough.

Mid-Atlantic

While current conditions of a much below normal snowpack and average to below streamflow conditions lead to a reduced risk of flooding across the Mid-Atlantic states from Virginia to Pennsylvania, heavy rainfall typical of the spring season can lead to flooding, even where overall risk is considered low.

Central Plains, Middle Mississippi Valley, Interior Southeast and Southern New England

There is very low chance of flooding over the Central and Southern Plains, as drought conditions persist from Colorado into Western Arkansas. While recent precipitation has offered some relief across parts of Oklahoma, drought has expanded across the Middle Mississippi Valley due to dry conditions during the winter and early spring. Warm temperatures during February and March have led to an early green-up of vegetation across most of the South. With

warm conditions expected to continue, this will create increased water demand from vegetation on an already stressed hydrologic system, exacerbating drought conditions in the region. Drought conditions also dominate northern portions of Alabama and Georgia into southern Tennessee and far western areas of North and South Carolina. In southern New England, drought conditions persist, with severe to extreme drought conditions across southern New Hampshire, western Massachusetts and parts of Connecticut. The primary factor in development of significant river flooding over most of the region is the occurrence of excessive rainfall in relatively short periods of time, even for areas where drought conditions persist or have developed. Please visit drought.gov for detailed outlooks, impacts and information related to your area.

Western U.S. - Regarding Spring Flood Prediction

Extensive flooding was experienced in many locations across the West as a parade of systems brought heavy rain to the region. Additionally, a warm February brought melting of low elevation snow and in some cases caused rapid runoff from rain falling on snow in parts of Washington and Idaho, leading to widespread flooding. These wet conditions leave many areas susceptible to additional flooding from systems through the remainder of the wet season. Mid-March is still too early to determine final spring flooding potential across the western United States due to snowmelt because heavy snowpacks at higher elevations are expected to persist and even build over the next month. However, due to the substantial snowpack, it is very likely that parts of Washington, Oregon, California, Nevada, Idaho, Wyoming and Utah will experience snowmelt flooding in the spring. The duration and intensity of flooding will depend on future precipitation and temperatures.

Snowpack in the Pacific Northwest is well above normal in the Cascades in Oregon and the Rocky Mountains from southern Idaho to northwest Wyoming, while snowpack is near or slightly below normal in the Cascades of Washington and the Rocky Mountains in northern Idaho and western Montana. Although February brought heavy precipitation across almost the entire Pacific Northwest, this disparity in snowpack is a reflection of abnormally wet conditions during December and January across the southern tier of this area.

Snowpack is significant in the Great Basin of Utah, Idaho, and Wyoming in the upper Colorado River basin, with many areas exceeding 150 percent of the historical median water content for early March with some exceeding 200 percent of median. The Green River (Wyoming), Duchesne River (Utah) Basins, and basins in the northern Great Basin have especially significant snowpack as of early March, many locations are at record high measurements, and already exceeding their seasonal peaks by 150% or more. In addition, soils at lower elevation areas are already saturated. There is a high probability of flooding in headwaters of the Green River, Duchesne River, and Bear River Basins, and reservoir operators are adjusting regulations now to make room for the impending large volumes of water expected to minimize the potential flooding downstream. Snowpack in the Great Basin of Nevada and in the Humboldt River basin is much above average. Snowpack in the Sierras is also much above average; statewide the snow water content is 181% of normal and already exceeds the average for the seasonal peak which typically occurs in early April.

There is still ample time left in the accumulation period, as snow accumulation typically occurs into April in many higher elevation areas in the West. Weather conditions preceding and during the melt period determine the threat of flooding. Rapid warming can lead to elevated melt rates. During the melt, when rivers and streams are flowing at or near capacity, any precipitation can increase the risk of flooding. As always, citizens are encouraged to monitor the forecasts from their local Weather Forecast Offices.

Western Water Supply

Water supply forecasts are produced for mountainous basins in the western United States that supply water for agriculture, municipalities, and industrial uses. Forecasts reflect current hydrologic conditions including snow pack, soil moisture, and weather and climate outlooks. As these conditions change, especially over the next couple months, forecasts will be updated to reflect these changes. Water supply forecasts are generated by NOAA/NWS River Forecast Centers and the Natural Resources Conservation Service (NRCS) National Water and Climate Center.

Current water supply forecasts and outlooks in the western United States range from below average in the Upper Missouri Basin to near to much above normal in the Pacific Northwest, across the Sierra Nevada, the Great Basin and into the upper Colorado River basin:

- Snake and Columbia Rivers - Median forecast is 139% of average for the Snake River at Lower Granite Dam and 113% of average for The Columbia River at The Dalles.
- Missouri River - Median forecast at Toston is 100% of average.
- Colorado River - Median forecast inflow for April through July for Lake Powell is 145% of average. The forecasts for basins across the Upper Colorado range from 100% of average in the Yampa River Basin to 240% of average in the Green River Basin.
- Eastern Great Basin (Utah) – Median forecasts range from 100% in the Sevier River Basin in southern Utah to more than 260% of average in the Bear River basin in northern Utah and southern Idaho.
- Western Great Basin (Nevada) - Median forecasts range from 150% to 275% of average.
- California - Median forecasts range from 125% of average to 275% of average, with most well above average.

These significant water supply forecasts reflect above average precipitation experienced this year across much of the region.

Snowpack in the Pacific Northwest is substantially above normal in the Cascades in Oregon and the Rocky Mountains from southern Idaho to northwest Wyoming, while snowpack is near or slightly below normal in the Cascades of Washington and the Rocky Mountains in northern Idaho and western Montana. The combination of above average precipitation and colder temperatures has boosted the ESP Water Supply Forecast throughout the Columbia and Snake River Basin. The April through September runoff forecast for the upper Columbia River at Grand Coulee Dam is at 105%. The Snake River currently has near record snowpack amounts at the higher elevations throughout much of the basin. Based on the substantially above average snowpack and observed precipitation in the Snake River Basin, the ESP Water Supply

Forecast ranges from 150% to 200% in the Snake River and tributaries. In the Oregon and Washington Cascades, the ESP April through September forecast is at or slightly above normal ranging from 95% to 115% of average.

Streamflow in the Upper Missouri Basin is forecast to be below average during the upcoming spring and summer due to a below average snowpack as of February 1. The St. Mary River is forecast to have 85 percent of average April-September flows. Runoff is expected to range around 98 percent of average for the Missouri Basin above Fort Peck, Montana. Forecast streamflow in the Yellowstone Basin ranges from below to above average for the upcoming spring and summer. Streamflow for the Bighorn River at St. Xavier, Montana is forecast to be about 147 percent of average. Where snowpack is near to below average, flow in the Tongue Basin is expected to be 75 percent of average and about 70 percent of average in the Powder River Basin. Above normal high elevation snowpack in the Platte Basin leads to streamflows forecast to be near average during the upcoming spring and summer. Runoff for streams above Seminoe Reservoir is expected to be about 135 percent of average. Streams in the South Platte Basin above South Platte, Colorado can expect 75 percent of average flow with flows are expected near 78 percent of average for the remainder of the South Platte Basin.

Record setting precipitation occurred in many areas throughout the Upper Colorado River Basin and Eastern Great Basin in January and again in the Green River Basin in February. Numerous higher elevation mountain precipitation sites in the Green River Basin of Wyoming, Bear River Basin, Weber River Basin, Six Creeks drainages, Provo River Basin, and Duchesne River Basin have received December through February precipitation that ranks as the highest in their 34-39 years of record. Across the Colorado River Basin and eastern Great Basin, water year (October 2016 - February 2017) precipitation is above average as of early March, exceeding 200 percent of average over parts of the Green River Basin of Wyoming and Bear River Basin. A very significant snowpack exists for early March across most of the Upper Colorado River Basin and Great Basin. Exceptions include parts of the Yampa and White River Basins where conditions are closer to the historical median. Water supply forecasts for April through July range from 76 to 305 percent of average at specific points. Inflow into Lake Powell is expected to be near 145% of average.

In the Lower Colorado Basin of Arizona and western New Mexico, February brought above average precipitation to the Little Colorado River and Verde River Basins and near normal to slightly below normal elsewhere. This came after a extremely wet December and January, with several high elevation sites in Arizona and New Mexico ranking in the top 5 of record for January. Wet conditions in late February pushed snow conditions in the Lower Colorado River Basin back above median at higher elevations in the Salt River Basin and Verde River Basin. Streamflow volume forecasts in the Lower Colorado River basin for the March-May period call for above median runoff in the Gila, Salt, and Verde and Little Colorado River basins. Reservoir storage in the Salt River basin is near 55 percent of capacity, Gila River Basin is at 25 percent of capacity, and Little Colorado River basin 40 percent of capacity.

Water year precipitation in the eastern Great Basin ranges from 110 to more than 200 percent of average, and similarly, snowpack conditions are also well above normal. Water supply forecasts range from 110 to 305 percent of average. Conditions are similarly favorable in the western Great Basin, where water year precipitation ranges from 74% to 736% of average

and snowpack conditions are near to above average. Water supply forecasts are well above average in the Nevada portion of the Great Basin, ranging from 205% to 508% of average.

Precipitation is much above normal for the water year across California and throughout the Sierra. Statewide snow water content is approximately 170% percent of the April 1st average. The April through July streamflow volume is forecast to be above normal to much above normal for the majority of streams across the state. As a result of this winter's record precipitation, the water supply situation in California has improved dramatically from past years. Storage for the major reservoirs in northern California range from 70-115% of average (39-87% of capacity) with continued improvement expected. Storage in the San Joaquin and Tulare basin reservoirs range from 99-170% of average (52-96% of capacity). This year's above normal snowpack in the mountains will continue to augment reservoir storage throughout the summer and fall.

Water Resources East of the Rockies

Projections of surface water availability provided by the National Weather Service play a crucial role in water resource decision making in other regions of the country. Warm, dry conditions in February during across much of the South and Southeast, in combination with early green-up of vegetation, may expand drought conditions through the Spring and Summer. The last six months has brought above normal precipitation to parts of West Texas, but recent lack of precipitation has led to dry soils and development of abnormally dry conditions to moderate drought in this area. The US Seasonal Drought Outlook indicates that the dryness will persist across portions of Oklahoma panhandle.

Alaska Spring Ice Breakup Outlook

The flood potential from snowmelt and ice jams throughout Alaska this spring is currently rated as normal. This would indicate that locations that often experience flooding during breakup are likely to see minor flooding if an ice jam forms downstream. This forecast is based on current ice thickness, observed snowpack, river freeze-up stage, and long range weather forecasts.

River Ice freeze-up and current Ice Thickness

March ice thickness data are available for a limited number of observing sites in Alaska. March 1st measurements indicate that ice thickness is generally normal to slightly above normal across most of the state with two exceptions. The ice on the Yukon River at Galena was significantly thicker than normal and the ice thickness measured on the Colville River at Colville Village was below normal. Accumulated freezing degree days trend from below normal along the North Slope of Alaska to near normal in the interior of Alaska to above normal in Southcentral and Southeast Alaska.

Snowpack

An analysis of the March 1st snowpack by the Natural Resources Conservation Service

(NRCS) indicates a generally below normal snowpack south of the Alaska Range, including Southeast Alaska. Areas along the Southern slopes of the western Alaska Range are well below average. North of the Alaska Range, there is an area of well above normal snowpack east of Fairbanks, but overall averages within the Middle and Upper Yukon basins are close to normal. Snowpack conditions along the Dalton highway on the North Slope of Alaska are near normal. For more details, please refer to the various snow graphics from the Alaska-Pacific River Forecast Center (APRFC) or from the NRCS.

Weather Forecasts

The most important factor determining the severity of ice breakup remains the weather during April and May. The temperature outlook for the next 90-days suggests an increased chance of below normal temperatures through March with the longer 90-days outlook showing equal chance of above or below normal temperatures for Eastern Alaska and an increased chance for above average temperatures in Western Alaska for the three months ending in May. For more information on the climate forecasts please refer to the Climate Prediction Center.

Spring Flood Outlook and Implications for Gulf of Mexico and Chesapeake Bay Hypoxia

The predicted spring flood risk across the Mississippi River watershed is anticipated to lead to average hypoxic zone conditions in the northern Gulf of Mexico this summer. Flood risk is predicted to be minor over major portions of the Upper and Lower Mississippi River basins with a large portion of the Ohio River basin predicted to be normal. These basins contribute the majority of nutrients flowing down the Mississippi River. Flood conditions, should they occur, may lead to higher than normal springtime discharges of nutrients and freshwater from the Mississippi River into the Gulf of Mexico, conditions that promote hypoxia formation and spread. This cause and effect relationship, however, can be confounded by weather events such as tropical storms and hurricanes, which can locally disrupt hypoxia formation and maintenance. There are areas of major and moderate flood risk identified but these areas fall outside of, or make up a relatively small percentage of the Mississippi River watershed.

In the northern Gulf of Mexico each year a large area of low-oxygen forms in the bottom waters during the summer months, often times reaching in excess of 5,000 square miles (the average area since 1985 is 5,312 square miles). This area of low-oxygen, otherwise known as the “dead zone”, is strongly influenced by precipitation patterns in the Mississippi-Atchafalaya River Basin (MARB) which drains over 41% of the contiguous United States. Changes in precipitation will influence river discharges into the Gulf, which carry the majority of nutrients helping to fuel the annual dead zone, so examining spring flood risk in the MARB can provide a useful indicator of the possible size of the dead zone during the summer months.

In the Chesapeake Bay, recurring summer hypoxia has also been linked to nutrient loadings and river discharge, especially from the Susquehanna and Potomac Rivers. The spring flood risk map for these basins does not indicate any minor or major flood risks so we anticipate an average hypoxia zone for the Chesapeake Bay in 2017. This assumes typical summer

conditions in the Bay region and the absence of major disruptive events such as tropical storms and hurricanes or drought conditions.

The spring flood outlook provides an important first look at some of the major drivers influencing summer hypoxia in the Gulf of Mexico and Chesapeake Bay. In early June, the actual river discharge rates and corresponding nutrient concentrations will be available from the U.S. Geological Survey. This information will be used by NOAA's National Ocean Service to release its annual dead zone forecast for the Gulf of Mexico and Chesapeake Bay which will provide an actual forecasted dead zone size based on the available nutrient loading data. In the summer, the dead zone sizes will be measured and compared against the predictions.

NOAA's Role in Flood Awareness and Public Safety

Floods kill an average of 89 people each year in the US. The majority of these cases could have been easily prevented by staying informed of flood threat, and following the direction of local emergency management officials.

To help people and communities prepare, NOAA offers the following flood safety tips:

- Determine whether your community is in a flood-risk area and continue monitoring local flood conditions at http://water.weather.gov.
- Learn what actions to take to stay safe before, during and after a flood at www.floodsafety.noaa.gov.
- Visit http://www.floodsmart.gov to learn about FEMA's National Flood Insurance Program and for flood preparedness advice to safeguard your family, home and possessions.
- Purchase a NOAA Weather Radio All- Hazards receiver with battery power option to stay apprised of quickly changing weather information.
- Study evacuation routes in advance and heed evacuation orders.
- Turn Around, Don't Drown – never cross flooded roads, no matter how well you know the area or how shallow you believe the water to be.

NOAA's National Weather Service is the primary source of weather data, forecasts and warnings for the United States and its territories. It operates the most advanced weather and flood warning and forecast system in the world, helping to protect lives and property and enhance the national economy. Visit us online and on Facebook.

NOAA's mission is to understand and predict changes in the Earth's environment, from the depths of the ocean to the surface of the sun, and to conserve and manage our coastal and marine resources. Visit us online or on Facebook.

About this Product

The National Hydrologic Assessment is a report issued each spring by the NWS that provides an outlook on U.S. spring flood potential, river ice jam flood potential, and water supply. Analysis of flood risk integrates late summer and fall precipitation, frost depth, soil

saturation levels, stream flow levels, snowpack, temperatures and rate of snowmelt. A network of 122 weather forecast offices and 13 river forecast centers nationwide assess this risk, summarized here at the national scale. The National Hydrologic Assessment depicts flood risk on the scale of weeks to months over large areas, and is not intended to be used for any specific location. Moreover, this assessment displays river and overland flood threat on the scale of weeks or months. Flash flooding, which accounts for the majority of flood deaths, is a different phenomenon associated with weather patterns that are only predictable days in advance. To stay current on flood risk in your area, go to http://water.weather.gov/ahps for the latest local forecasts, warnings, and weather information 24 hours a day.